2361X

GERTSCH

METROLOGY GROUP

OPERATING INSTRUCTIONS

FOR

MODEL PT SERIES

STANDARD RATIO TRANSFORMERS

ELECTRONIC INSTRUMENTS

OPERATING INSTRUCTIONS

FOR

MODEL PT SERIES

STANDARD RATIO TRANSFORMERS

GERTSCH PRODUCTS, INC.
11846 Mississippi Avenue
Los Angeles 25, California

1471-1541
4C 405196
#5017906

GERTSCH

PT-SERIES

Standard Ratio Transformers

PT-1
Carrying Case Model
(Typical)

PRECISION AC VOLTAGE DIVIDERS

GENERAL DESCRIPTION PT SERIES STANDARD RATIO TRANSFORMERS

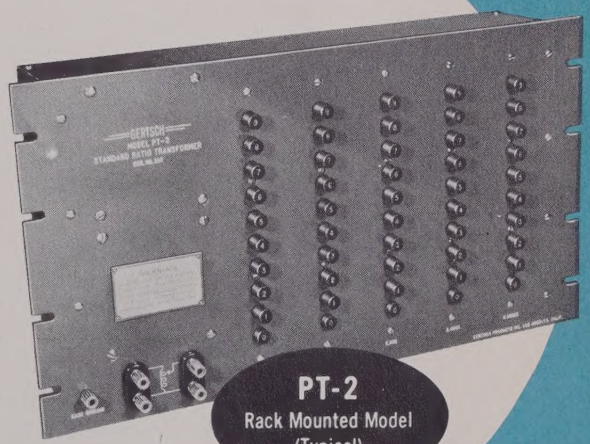
Precision Auto-Transformers capable of Extreme Accuracy and Resolution in the Measurement and Generation of AC Voltage Ratios.

The same basic principle of operation is applicable to all units in the Series, however each has been designed for a specific application.

PT-1 A wide frequency range unit with limited input voltage characteristics at lower frequencies. Uses push button selection for the first three digits and a ten turn potentiometer for the remaining.

PT-2 Covers the same frequency and voltage ranges as the PT-1. The potentiometer is eliminated and replaced with two push button selected decades, allowing five decade push button selection.

PT-3 Mechanically identical to the PT-2, i.e., uses five push button selected decades. Designed specifically for higher voltage inputs at the lower frequencies, necessarily restricting the high frequency range.



PT-2
Rack Mounted Model
(Typical)

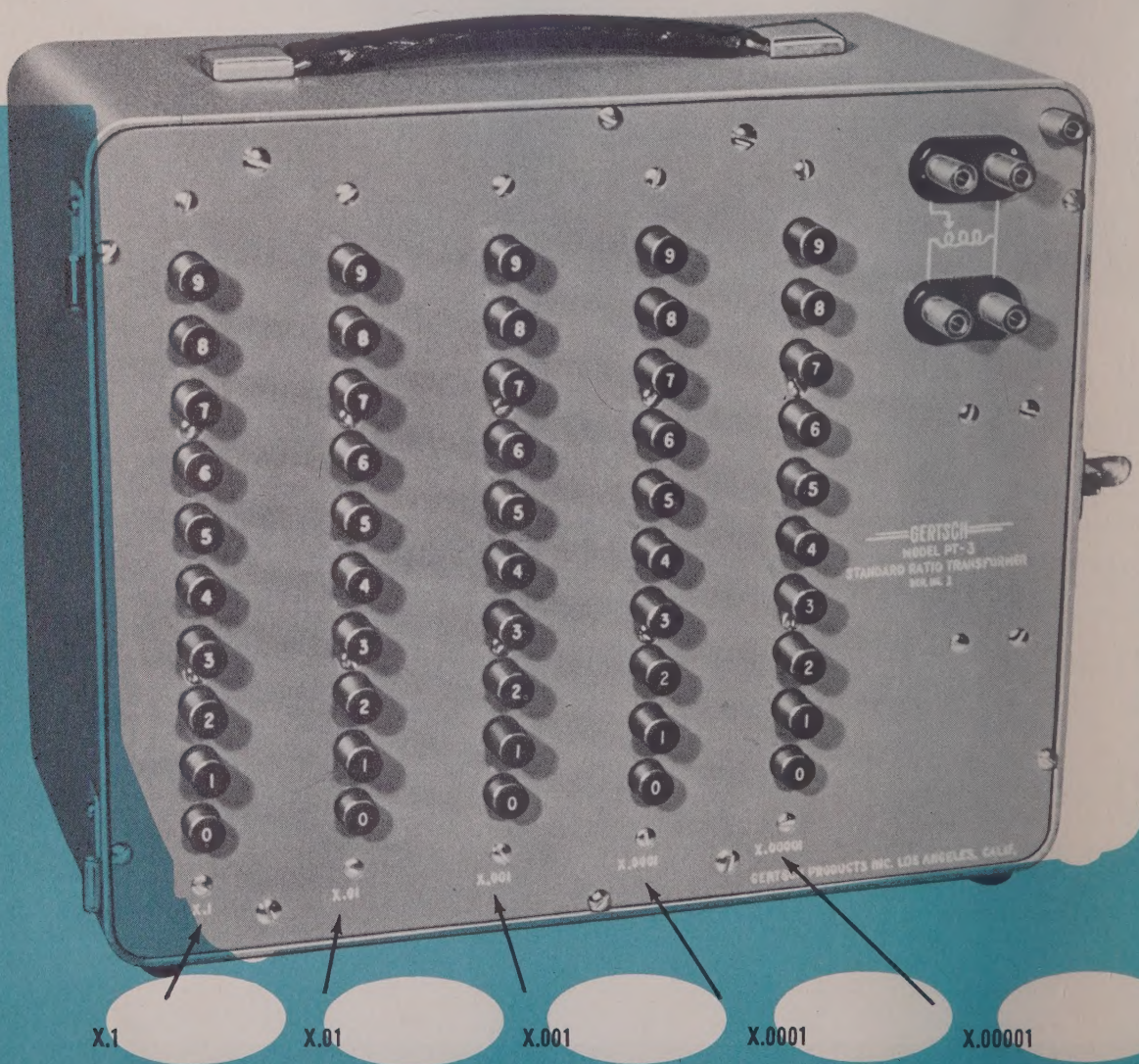
GERTSCH PRODUCTS, INC.

11846-48 Mississippi Avenue
Los Angeles 25, California
Phone BRadshaw 2-1795

MECHANICAL SPECIFICATIONS

Each unit in the Series is available either with drawn aluminum carrying case (with removable front cover) or rack mounted (with protective dust cover). Rack mounted units can be supplied complete with aluminum case at additional charge. When ordering, specify carrying case type, rack mounted type, or rack mounted type with case.

	PT-1	PT-2	PT-3
DIMENSIONS	Rack 19 x 10½ x 4 in. Case 11 x 13 x 5¾ in.	Rack 19 x 10½ x 4 in. Case 11 x 13 x 9 in.	Rack 19 x 10½ x 9 in. Case 11 x 13 x 9 in.
WEIGHT	10 lbs.	13½ lbs.	22 lbs.

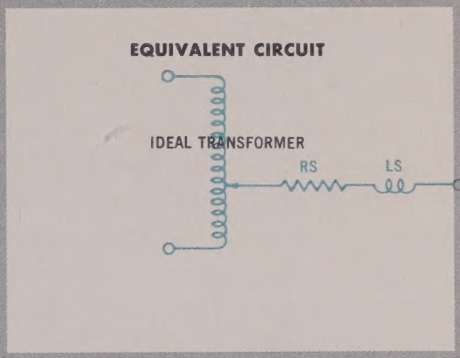


FRONT VIEW

PT-3
(Cover Removed)

ELECTRICAL SPECIFICATIONS

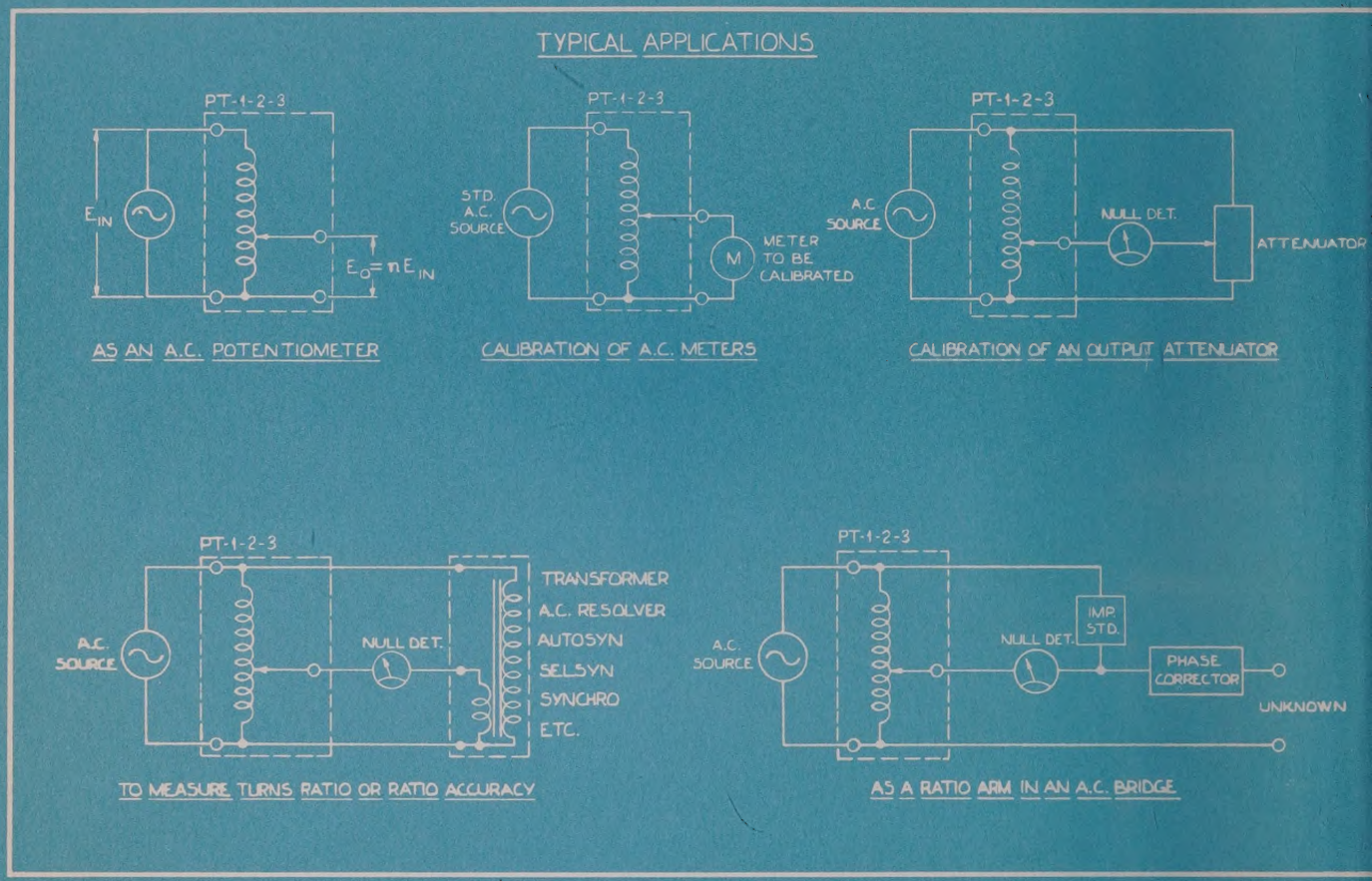
Accuracy of Indicated Ratios (Loaded Condition): The accuracy is a function of the load applied. Assuming an Ideal Transformer looking into the arm we see an impedance (Ls and Rs) in series with the arm, which is due to leakage inductance, wiring resistance, switch resistance, potentiometer resistance and other stray circuit parameters. From these series impedances, the effect of loading upon the transformer and overall accuracy can be calculated. In the assumption of the Ideal Transformer the indicated unloaded accuracies apply at the arm of the assumed Ideal Transformer.



PERFORMANCE CHARACTERISTICS · PT SERIES
(Unloaded)

	PT-1	PT-2	PT-3
Design Characteristics	Continuously Variable Output	Maximum Accuracy Min. Output Impedance	High Voltage at Low Frequency
Recommended Frequency Range	50-10,000 cps.	50-10,000 cps.	30-1000 cps.
Resolution % of Input	Continuous .0001% Divisions	.001% Steps	.001% Steps
Accuracy of Indicated Ratio 50 cps.—3 KC (PT-1 and PT-2) 30-1000 cps. (PT-3)	$\pm(.004\% + \frac{.0006\%}{R})$ Including Pot. $\pm(.004\% + \frac{.0001\%}{R})$ Pot. Set to Zero	$\pm(.004\% + \frac{.0001\%}{R})$	$\pm(.004\% + \frac{.0001\%}{R})$
Accuracy of Indicated Ratio 3.0-10 kc.	$\pm(.01\% + \frac{.0006\%}{R})$ Including Pot. $\pm(.01\% + \frac{.0001\%}{R})$ Pot. Set to Zero	$\pm(.01\% + \frac{.0001\%}{R})$	
Maximum Input Voltage ERMS Max.	.35f, f in CPS 350 volts above 1000 CPS	.35f, f in CPS 350 volts above 1000 CPS	2.5 f, f in CPS 350 volts above 140 CPS
Maximum Effective Series Resistance (RS)	12 ohms Ratio .545500 5 ohms Ratio .545000 (Transformer Only)	3 ohms	4 ohms
Maximum Effective Series Inductance (LS)	160 uh. at 1.0 KC 100 uh. at 10 KC	160 uh. at 1.0 KC 100 uh. at 10 KC	700 uh. at 1.0 KC
Approximate Input Inductance	150 henries	150 henries	500 henries
Phase Angle (Unloaded)	Dependant upon frequency and ratio setting, but very small.		

TYPICAL APPLICATIONS

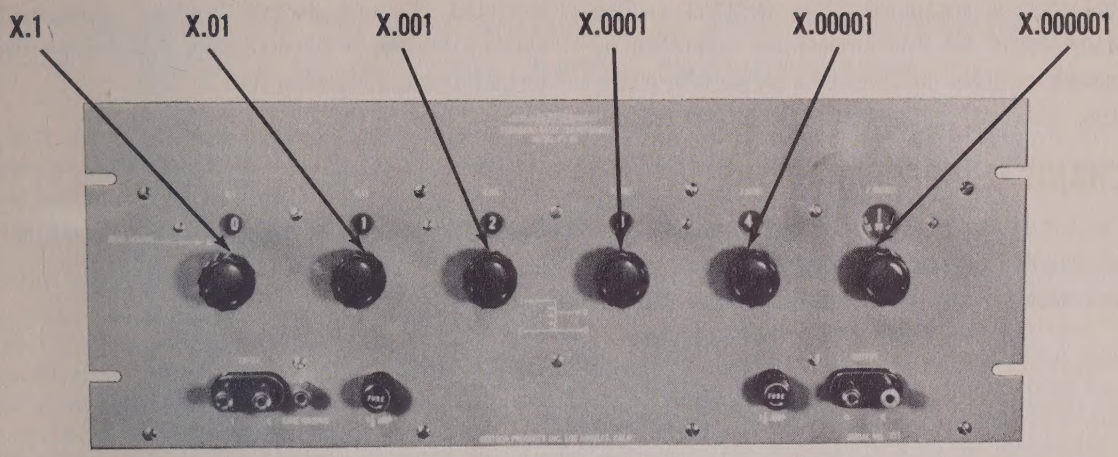


The above Application Diagrams omit the bridging transformer required to isolate the Null Detector. For those applications where a Null Detector is necessary, Gertsch Products, Inc. has designed the Model 100 Bridge Transformer, suitable for this purpose, as well as for many other bridge applications. For applications which require 180° phase shift at unity voltage ratio, the Gertsch Model 200 Transformer is also available. For further data concerning the Model 100 and Model 200 Transformers see Gertsch brochure illustrating those items.

FOR FURTHER INFORMATION REGARDING THE PT SERIES AND OTHER GERTSCH PRODUCTS, CONTACT THE FACTORY OR YOUR NEAREST GERTSCH ENGINEERING REPRESENTATIVE.

REPRESENTED BY:

GERTSCH

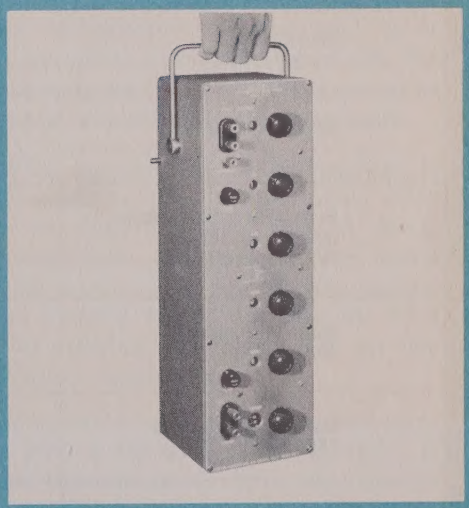


PT-5 shown above — typical Rack Mounted Model
PT-4 similar except for size (see dimensions)

STANDARD RATIO TRANSFORMER – PT-5

Shown here are versions of the PT-5 Standard Ratio Transformer. Above, rack mounted model; below, case model with convenient new handle for either carrying or for easy reading in table position.

Convenient
tilt-up handle



GERTSCH PRODUCTS, INC.

11846-48 Mississippi Avenue
Los Angeles 25, California

GENERAL DESCRIPTION

The PT-4 and PT-5 permit rapid selection of accurate voltage ratios by means of rotary switches . . . Two toroidally wound autotransformers are controlled by five decade switches followed by a single turn potentiometer, providing continuous resolution and readout of better than six significant figures . . . Ratio value is indicated as direct decimal reading . . . Every switch position displays its corresponding digit through a dust proof transparent window.

MECHANICAL SPECIFICATIONS

Each unit is available either in a cast aluminum case or rack mounted with cast aluminum dust cover. Carrying case models are provided with dual purpose handles. These may be used for carrying the instrument or for bench "Tilt-Up" operation. (See PT-5 photo).

DIMENSIONS

	PT-4	PT-5
Case	17" x 8¼", 6¾" high	17" x 5¼", 5½" high
Rack	Std. 8¾", 6⅜" deep	Std. 7", 5¼" deep

SPECIFICATIONS

	PT-4	PT-5
Design Characteristics	High Voltage Input at Low Frequencies	Maximum Accuracy Min. Output Impedance
Recommended Frequency Range	30-1,000 cps.	50-10,000 cps.
Resolution % of Input	Continuous	Continuous
Accuracy of Indicated Ratio 30-1, 000 cps (PT-4) 50-3,000 cps (PT-5)	$\pm(.004\% + \frac{.0001\%}{R})$	$\pm(.004\% + \frac{.0001\%}{R})$
Accuracy of Indicated Ratio 3-10 KC.		$\pm(.01\% + \frac{.0001\%}{R})$
Maximum Input Voltage ERMS max.	2.5 f, f in cps. 350 volts above 140 cps.	.35 f, f in cps. 350 volts above 1,000 cps.
Maximum Effective Series Resistance (RS)	4—ohms	3—ohms
Maximum Effective Series Inductance (LS)	350 uh.	75 uh.
Phase Angle (Unloaded)	Dependent upon frequency and ratio setting, but very small.	

LITHO IN U.S.A. BY PARKER ENTERPRISES,

Applicable to all PT Series

ADDITIONAL DATA ON THE ACCURACY AND SPECIFICATIONS OF THE MODEL PT-1, RATIO TRANSFORMER

Theoretical analysis of a perfect auto transformer or step-down purposes shows that if the leakage inductance and the winding resistance are uniformly distributed and the turns can be accurately tapped, the accuracy for no load is perfect. Neglecting winding resistance for the moment and considering leakage inductance alone, it is seen that the maximum error due to non-distributed leakage inductance approaches one over the permeability of the core material. In the case of the PT-1, the core material is supermalloy and it has an effective permeability of 70,000 for low frequencies. Thus it is seen that the maximum error to be expected from this cause would be somewhat less than .002%. Non-distributed resistance affects the accuracy in exactly the same manner as non-distributed leakage inductance. Measurements on one of the PT-1 Transformers show that the magnitude of error at 60 cycles caused by non-distributed resistance is insignificant in comparison to the other errors present. These errors become even less significant as the frequency is raised.

Other factors which enter into the accuracy are:

1. Inductance of connecting leads to the transformer.
2. Resistance of connecting leads to the transformer.
3. Loading effects of the potentiometer.
4. Non-linearity and end effects of the potentiometer, that is, the potentiometer not going to zero resistance or not going to full scale.

The first two of these effects are very difficult to evaluate. From the results of measurements taken, it appears that they are possibly one of the main sources of error. Potentiometer loading causes the voltage at the zero end of the potentiometer to be roughly .0001% high with respect to the input voltage and the voltage at the full scale end of the pot to be .0001% low with respect to the full scale voltage. The error at the center of the potentiometer is zero due to this effect. Linearity of the potentiometer enters in in that the potentiometer is across one turn of the 1000 turn transformer. This introduces into the accuracy a sliding scale factor of .0005% since we are using a .5% potentiometer.

Distributed capacitance does not seem to play a very important part until frequencies of the order of 10 kc. are reached. At this point the permeability of the core is also decreasing rapidly so that the performance of the transformer as a whole deteriorates considerably above 10 kc.

We do not have available in our plant any standards suitable for measuring ratios with the accuracy required to be able to specify the accuracy of the PT-1. Such equipment exists in only very few places in the Country. A method which can be used to prove the accuracy consists of obtaining a series of identical resistors. It is not too difficult to construct resistors equal to each other with great precision. If these resistors are then connected in a voltage divider chain it is possible to obtain measurements on the PT-1 to the accuracy required. This has been done using three resistors to obtain a division ratio of 1/3 and 2/3. The PT-1's indicated ratio was in error by less than ten parts in a million on this particular test. This particular test is the only reliable test that we have made to date on the ratio accuracy of the PT-1. This particular PT-1 remains in our laboratory as a standard against which all other PT-1's are checked throughout their total range, that is, every step and throughout the range of the potentiometer. The PT-1 to be tested and the standard PT-1 are hooked up in a bridge circuit and nulled against each other and the deviation noted. All PT-1's generally run within five parts in a million of the total input against the standard PT-1. This is in itself a fairly good check on the accuracy of the PT-1's since they are so reproduceable. Another check is to reverse the input connections of the PT-1 under test. The two ratios indicated must add up to one. They generally do this within five parts in a million of the total input.

The Model PT-2 does not use the potentiometer to divide the voltage across one turn. It uses instead a 100 turn transformer to obtain two more rows of decade buttons. From theoretical considerations, this should remove many of the errors due to potentiometer loading and potentiometer linearity affects and give the PT-2 an over-all greater accuracy specification. As yet this has not been definitely determined.

All of the foregoing considerations and conclusions assume that the PT-1 is unloaded. When the PT-1 is loaded, the internal impedance of the PT-1 itself must be taken into account. This is covered in the brochure.

GERTSCH PRODUCTS, INC.
11846-48 Mississippi Avenue
Los Angeles 25, California

If the leakage inductance is uniformly distributed, it can be said that the same amount of flux passes through each turn of the transformer. Therefore, the voltage induced across each turn is equal. Also, if the leakage flux for each turn is equal, the voltage dropped across the leakage inductance is equal. Similarly, for equal resistance in the turns, the voltage dropped across the resistances must be equal. Since the voltage across each turn is the vector sum of all these voltages and each component is equal for all turns, the total voltage across each turn is equal. The foregoing analysis applies only if the same current flows through each turn. This is true only if the auto transformer is unloaded.

Leakage inductance depends mainly on the size and geometric configuration of the coil. It is almost independent of the core since most of the leakage flux goes through air. The inductance of a toroidal coil with a core is roughly the inductance of the coil without a core, multiplied by the permeability of the core. This is true if the coil is wound as tighly as possible to the core. Considering the inductance of the coil with no core to be equal to the leakage inductance of the coil with a core, the ratio of total inductance to leakage inductance is the effective permeability of the core. Therefore, the fractional part of the voltage dropped in the leakage inductance is 1/u times the voltage in the perfectly coupled portion of the coil where u is the effective permeability of the core. Due to the configuration of the coil used, it is very unlikely that there is a departure of more than $\pm 50\%$ of the mean leakage inductance per turn in any given turn. Therefore, there is a possibility of error as great as $\pm 50\%$ in the voltage dropped in the leakage inductance of any group of turns. But this voltage is only 1/u times the voltage in the perfectly coupled inductance. Therefore, the fractional error in the total voltage across any group of turns is not likely to exceed 0.5/u.

ADDITIONAL INSTRUCTIONS FOR PT SERIES STANDARD RATIO TRANSFORMERS

Care must be taken when using the PT Series Standard Ratio Transformers with a high voltage input from a fairly low impedance source. Due to the switching arrangements, if two buttons in any given row are pushed at the same time, part of the transformer is shorted out. Circulating currents in this shorted section of the transformer can become very high and possibly either damage or burn out the transformer. For the same reason, if buttons are pushed very rapidly the winding may become shorted for an instant due to the inertia of the switch. This occurs when one button is pushed just as fast that the [illegible] previously down does not have time to disengage from its contacts before the button being pressed makes contact.

While these transient short circuits are not of particular danger to the transformer, they do cause considerable arcing at the contacts of the switches and are very likely to blow fuses when buttons in the first row are pressed. For this reason, it is recommended that a 4 amp. series impedance be inserted with the source to limit the maximum short circuit current to 4 amps. This procedure will save many blown fuses and also prolong the life of the switches. The other terminals of the bridge circuit should be connected directly across the transformer.

There is no way which we can protect the PT Series Transformers from a burned out winding in case two buttons are pressed in the same row. In some extreme cases, particularly in the first row of buttons, the primary fuse may blow and protect the transformer.

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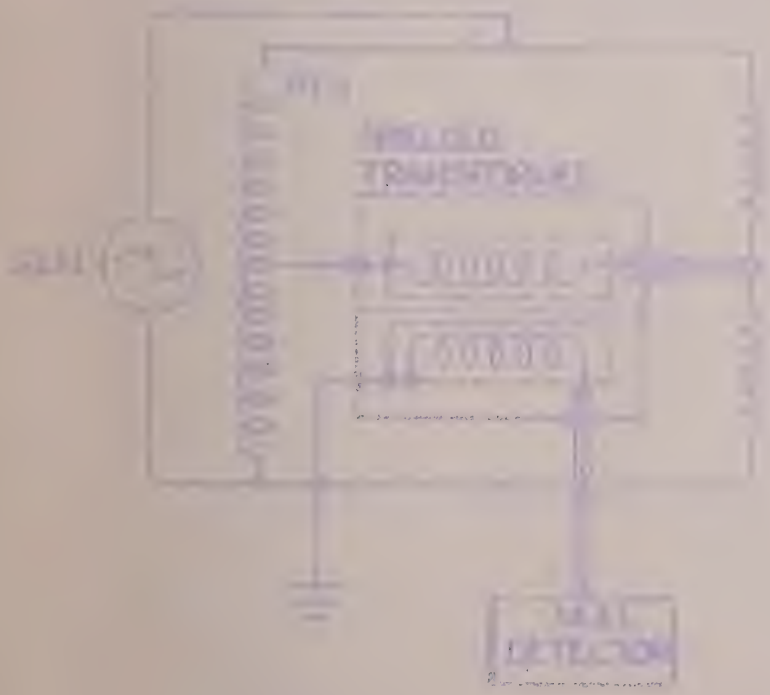
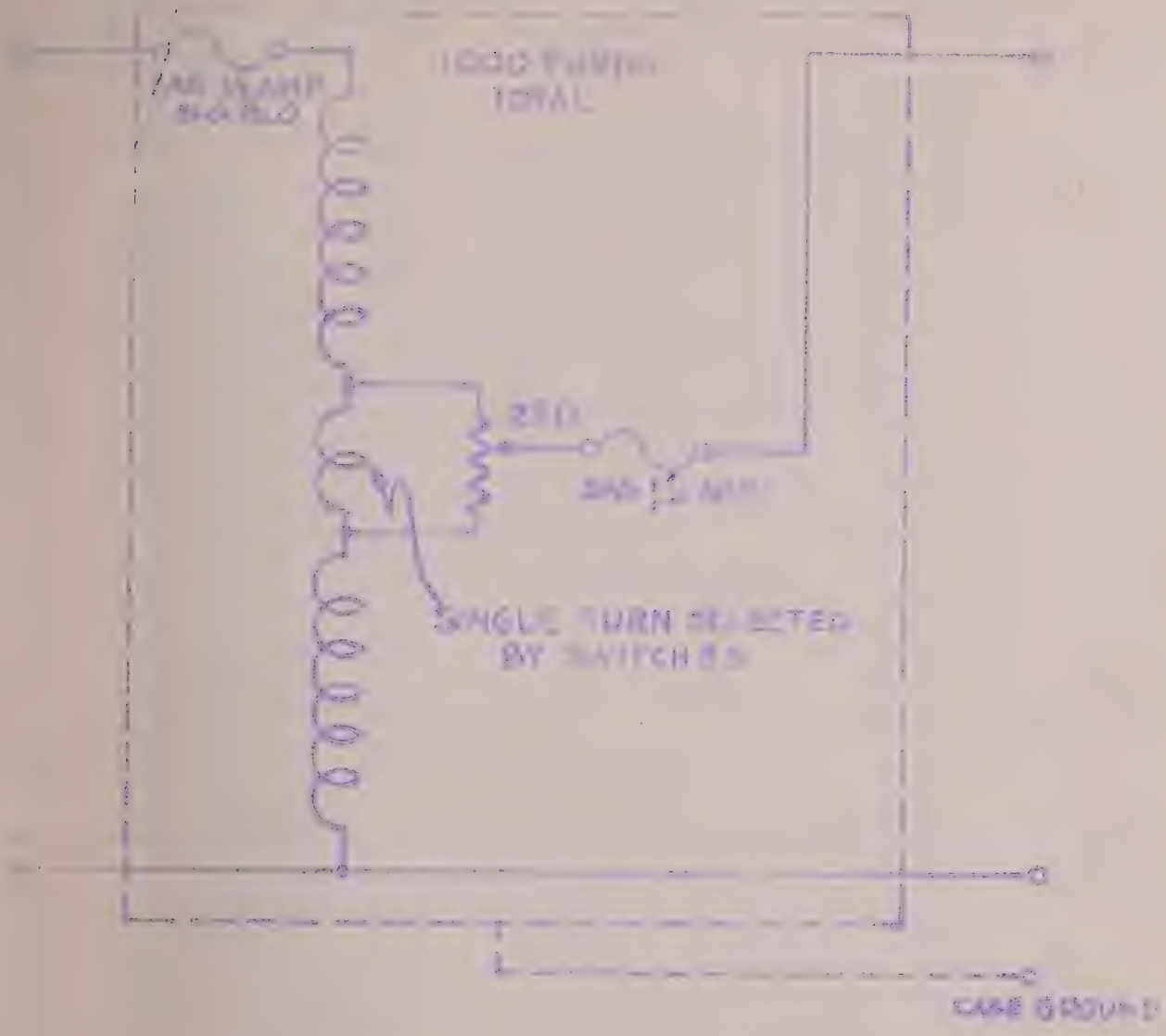
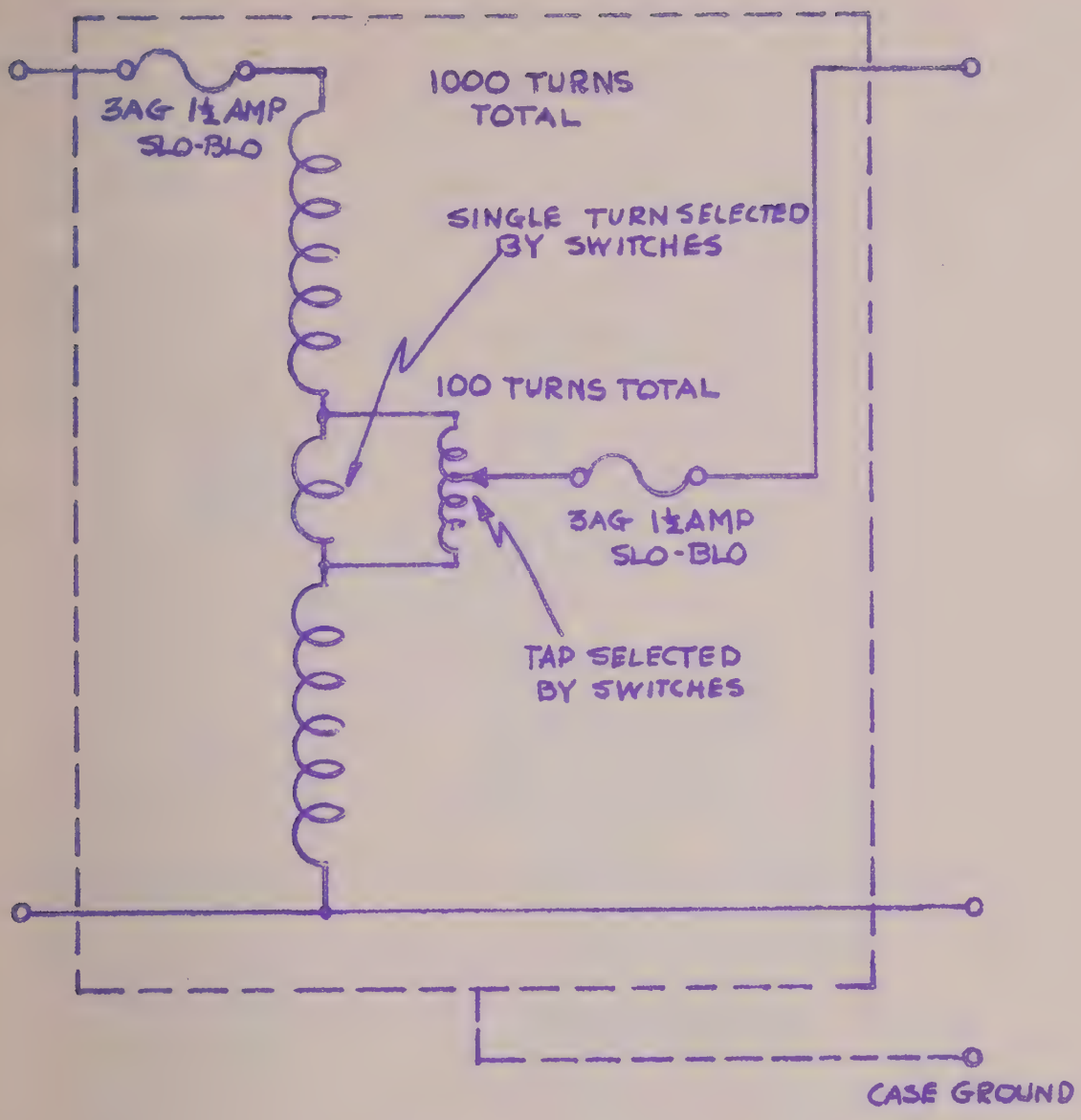
11846 Mississippi Ave.
Los Angeles 25, Calif.





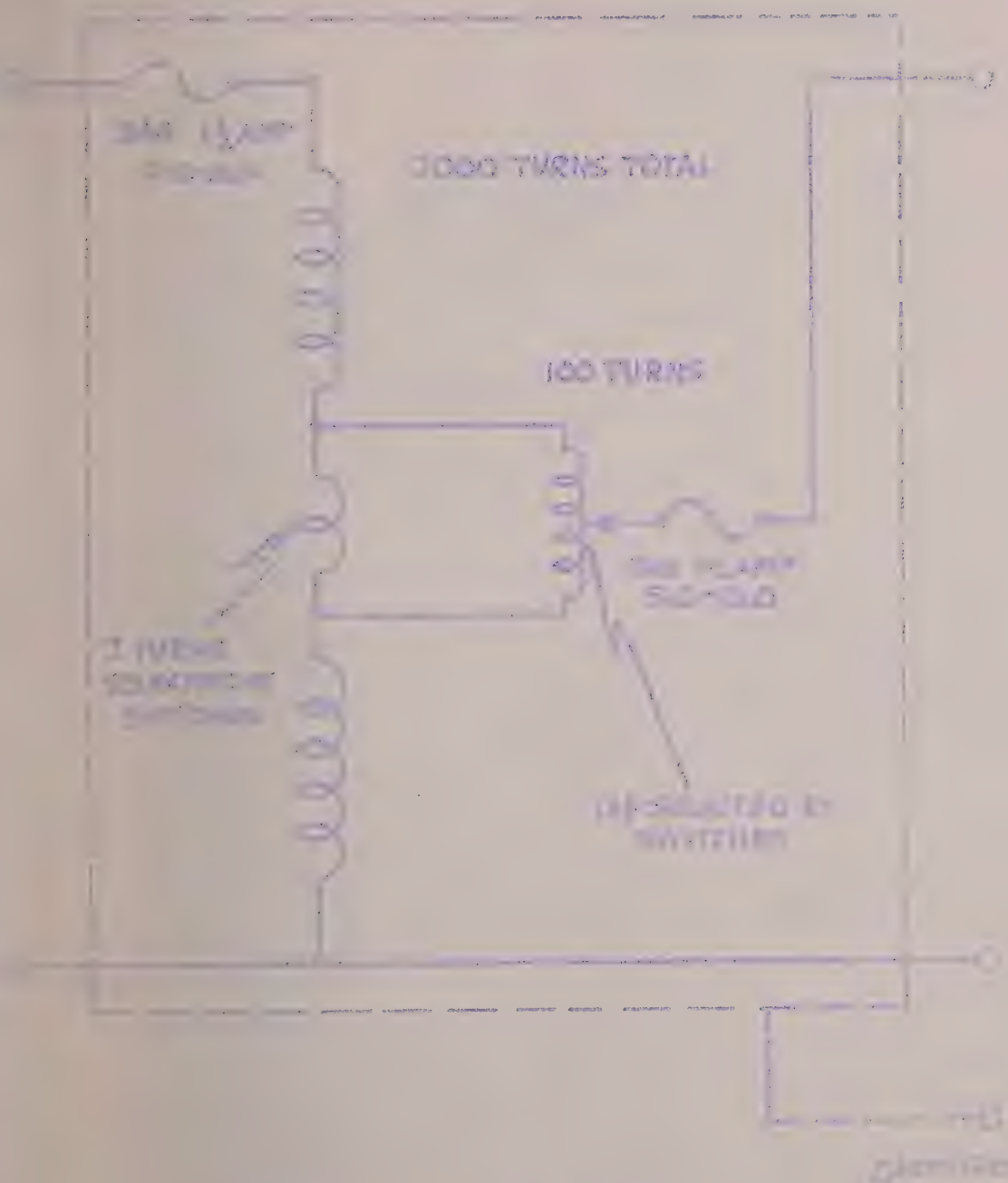
PT-1 SCHEMATIC

8-2-54



PT-2 SCHEMATIC

8-6-54 G.C.C.

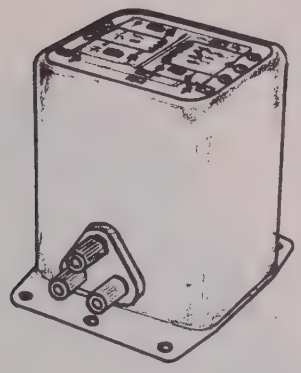


PT-3 SCHEMATIC

GERTSCH PRODUCTS, INC.

11846-48 Mississippi Avenue — Los Angeles 25, California
BRadshaw 2-1795 ARizona 9-1696
Mailing Address: P. O. Box 25856, W. Los Angeles 25, California

MODEL 100 BRIDGE TRANSFORMER



USES:

The Model 100 Double Shielded Transformer is designed for use with Gertsch Standard Ratio Transformers to isolate the Null Detector from the Bridge. It can also be used in A. C. bridges to isolate the detector or generator from the measuring network, to provide a balanced output from an unbalanced generator, and many other applications where isolation is desired.

DESCRIPTION:

In the Model 100 each winding is individually shielded. Intershield capacitance has been reduced to less than 25 mmf. Turns ratio of 3 to 1 can be used to step up or down generator output to bridge.

SPECIFICATIONS:

Turns Ratio: 3 to 1
Frequency Range: 20 - 10,000 cps. Unloaded
D. C. Resistance: 90 ohms Lo Z, 920 ohms Hi Z.
Insulation: 500 V. Test
Input Voltage: 115 V. at 60 cps. into Hi Z winding at rated load.
Capacitance:

EACH MODEL 100 BRIDGE TRANSFORMER IS BRIDGED TO DETERMINE INTERNAL CAPACITANCES AND THESE VALUES PLAINLY MARKED ON EACH TRANSFORMER.

Dimensions: 4 7/8 x 4 1/4 x 3 11/16
Weight: 5 lbs.

GERTSCH

Short Form Catalog

cision Electronic Instruments

FREQUENCY METERS

UF through microwave

FREQUENCY INTERPOLATORS AND MULTIPLIERS

UF through microwave

STANDARD RATIO TRANSFORMERS

AC voltage dividers

PEAK READING WIDE BAND PULSE VOLTMETERS

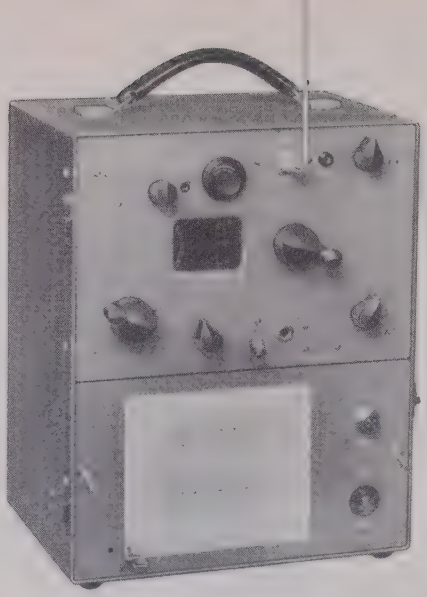
FILTERS

Subsonic, sonic, and ultrasonic

Precision Electronic Instruments

Gertsch Products, Inc. · 11846 Mississippi Avenue, Los Angeles, California

VHF Frequency Meter



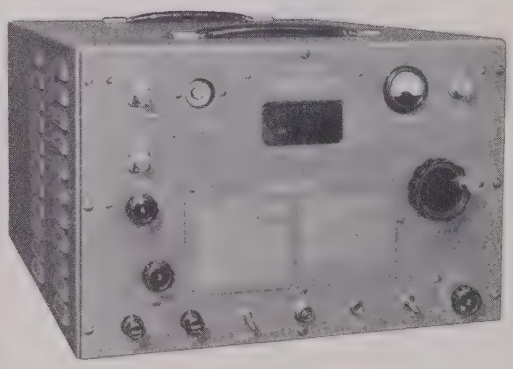
Gertsch FM-3 SERIES

Extremely accurate and stable (.001%) unit designed for measurement and generation frequencies. Basic frequency range 20 - 40 m Using harmonics, will measure and genera frequencies from 20 to 640 mc. and up to 10 mc. under certain conditions, with continuo coverage over the entire range. Frequenci down to 1 mc. can be measured. May be use to set peak deviation on FM transmitters.

Direct reading (no calibration book necessary Exceeds FCC requirements for accuracy ar stability. May be standardized against W.W. Internal 1 kc. modulation.

Model FM-3 (battery operated) **$625.**
Model FM-3/PS-3 (AC power operated) **$675.**
Model FM-3R (rack mounted) **$695.00** witho metal cabinet, **$725.00** with cabinet.
Model FM-3 with PS-3C power supply **$675.**

Microwave Frequency Multiplier



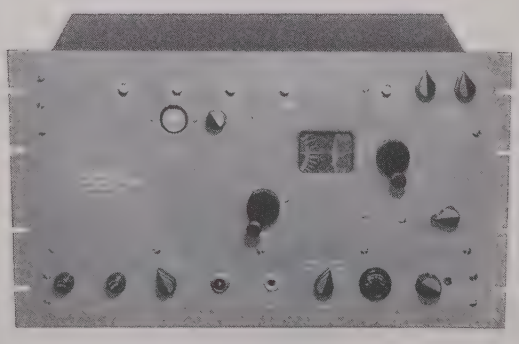
Gertsch FM-4

Designed to extend the range of existing equi ment into the microwave region. Basic fr quency range is 500 - 1000 mc. Using harmonic it will measure and generate frequencies fro 500 to 12,500 mc. and above under certain co ditions, all with continuous coverage. It w measure frequencies down to 100 mc.

The accuracy and stability is primarily a functi of the driving unit. For example, when driv by the FM-3, the accuracy and stability c .001%. When driven by the AM-1, with prop auxiliary equipment, accuracy and stability c as good as .00001%.

Model FM-4 **$1,500**
Model FM-4R (Rack mounted) **$1,500**

VHF Interpolator



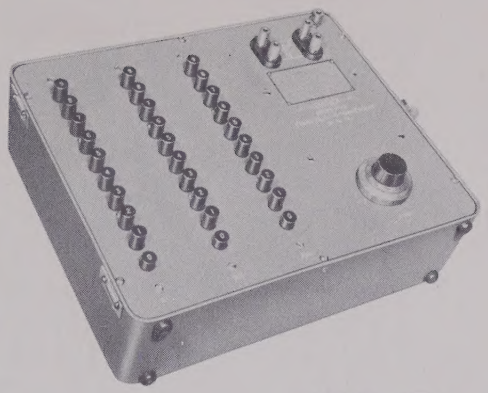
Gertsch AM-1

Auxiliary equipment designed primarily to e tend the range of existing frequency standar Using harmonics, it is capable of measuri and generating any frequency within the ran of 20 - 1000 mc. It requires, for operation, input from a 100 kc. standard and (2) equ ment to measure accurately frequencies b tween 1 and 2 megacycles, such as a count

Its accuracy and stability are primarily a fu tion of the 100 kc. source and the 1 - 2 m measuring equipment. Accuracies as good 1 part in 10^7 (1 cycle in 10 megacycles) c be obtained. Ultimate accuracy approaches part in 10^8.

Model AM-1 **$1,500**

Standard Ratio Transformer



MODEL PT-1

Gertsch PT SERIES

Precision auto-transformers (AC voltage dividers) capable of extreme accuracy and resolution in the measurement and generation of AC voltage ratios. The PT-1, PT-2, and PT-3 are push-button switch types. The PT-4 and PT-5 are rotary switch types.

PT-1 **$305.00** Ratio can be set by means of 3 decade switches and a ten turn potentiometer. Accuracy $\pm$ (.004% + $\frac{.0006\%}{R}$) where R is ratio. Range 50 - 3000 cps.

PT-2 **$400.00** Same as PT-1 except potentiometer is replaced with 2 extra decade switches. Accuracy $\pm$ (.004% + $\frac{.0001\%}{R}$), range 50 - 3000 cps.

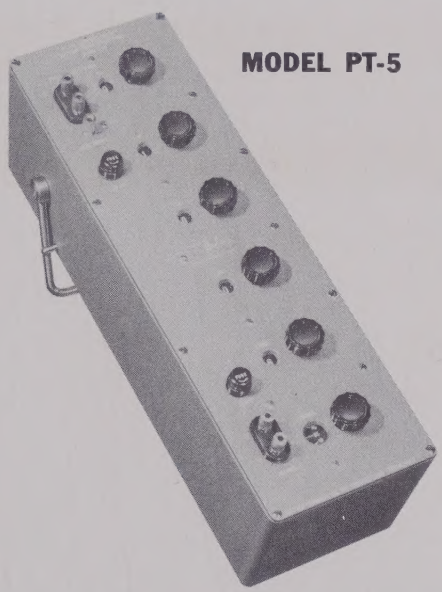
PT-3 **$500.00** Same as PT-2, except for higher voltage at lower frequencies. Particularly useful at 60 cycles. Accuracy $\pm$ (.004% + $\frac{.0001\%}{R}$), range 30 - 1000 cps.

PT-4 **$500.00** 5 decade switches and a one turn potentiometer. Accuracy $\pm$ (.004% + $\frac{.0001\%}{R}$), range 30 - 1000 cps. Equivalent to PT-3.

PT-5 **$400.00** 5 decade switches and a one turn potentiometer. Accuracy $\pm$ (.004% + $\frac{.0001\%}{R}$). Frequency range 50 - 3000 cps. Equivalent to Model PT-2.

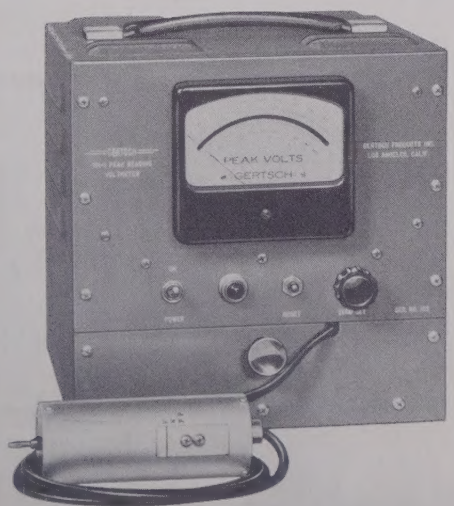
Case and rack models available for all types.

Standard Ratio Transformer



MODEL PT-5

Peak Reading Vacuum Tube Voltmeter



Gertsch VM-1

The Model VM-1 is a true Peak Reading Vacuum Tube Voltmeter, designed to measure either positive peak, negative peak, or peak to peak voltage of repeated pulses with very short duty cycles (.000001). Basic instrument has a range of 0-100 volts full scale. The following multipliers are available: VM1-A, 300 V; VM1-B, 1000 V; VM1-C, 3000 V; VM1-D, 10 and 30 kv. Accuracy of basic instrument, 3% of full scale. Accuracy with multipliers, 5% of full scale.

VM1 — $346.00; VM1-A, B, C — $52.50 each; VM1-D — $150.00.

OTHER GERTSCH PRODUCTS

BP SERIES FILTERS

Passive filter units with extreme attentuation outside the pass band (at least 40 db) and sharp cut-off (attentuation rate 80 db per ½ octave). Can be used as low pass, high pass or band pass.

BP-1 — Range 37.5 - 13,600 cps in half octave steps. Hi and Lo-pass sections can be used in tandem to provide band pass in multiples of ½ octave. 600 ohms.
$2,000.00

BP-2 — Similar to BP-1 but 10 kc. - 160 kc. 135 ohms.
$1,500.00

BP-3 — Similar to BP-1 but 6.65 cps - 37.5 cps. 600 ohms. Available on special request.

PS-3 POWER SUPPLY

Regulated power supply for use with FM-3. Provides operation at either 110 or 220 volts, 50/60 cycles. **$50.00**

PS-3C POWER SUPPLY

Cased portable version of the PS-3. Used with FM-3 when both AC and battery operation are desired. **$50.00**

MODEL 100 TRANSFORMER

Double shielded bridging transformer for bridge circuit use. Each transformer individually measured and marked with important capacities. **$30.00**

MODEL 200 TRANSFORMER

Unity ratio 180° phase inverting transformer. **$50.00**

All data and prices subject to change without notice. Prices F.O.B. factory.

FOR FURTHER INFORMATION REGARDING GERTSCH PRODUCTS, CONTACT THE FACTORY OR YOUR NEAREST ENGINEERING REPRESENTATIVE

Albuquerque, New Mexico
Neely Enterprises
107 Washington St., S.E.
Albuquerque 5-5586

Atlanta 5, Georgia
Bivins and Caldwell
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CHerokee 7522

Boston, Massachusetts
Robert A. Waters, Inc.
4 Gordon Street
Waltham 54, Mass.
WAltham 5-6900

Chicago 40, Illinois
Alfred Crossley & Associates
4501 No. Ravenswood Ave.
UPtown 8-1141

Cleveland 21, Ohio
S. Sterling Company
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EVergreen 2-4114

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WAlnut 1-2361

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